

Mineral Resource

The Future of Power in Arizona

by Dr. Madan M. Singh

Recently Arizona Public Service (APS) has received a 4.6 percent rate increase for the electric power it supplies because of the high cost of natural gas, and has been granted another 0.6 percent surcharge. In addition, an average increase of 7.6 percent has been granted to the utility by the Arizona Corporation Commission (ACC). According to The Arizona Republic, "This was among a handful of bill-increase requests" that APS has requested ACC for approval. Among these is a general-rate increase that may go to the Commission around October of this year.

However, this seems to be just the start of escalating energy prices. The price of oil and natural gas may be expected to rise in the future. Last year the price of oil was predicted to reach \$100 per barrel. This did not happen, and the price retreated after having hit a high of \$70.85 per barrel in August 2005. However, the price has reached \$75 per barrel this year, and could increase further because of international concerns and disruptions in supplies.

With the increasing cost of fuels, other sources for generating power need to be considered. The chart on the next page presents some of the advantages and drawbacks of various options that are available.

Currently the use of solar (photovoltaic), wind, and biomass are being seriously considered as future contributors to the power mix. In fact, the ACC has stipulated that 15 percent of the electric power supplied by the major power companies by 2025 should come from these sources. For Arizona, the use of solar panels seems appropriate, because of the ample sunshine that is available. Its use will increase with time, especially if the costs can be reduced somewhat – particularly for individual homeowners.

Wind energy is a serious contender, but finding suitable locations is not easy. Large open spaces are needed with relatively continuous winds, but not strong gusts. Windmills occupy a lot of area – a 1,000 MW-hr- plant may require about 235 square miles (which is approxi-

mately one-half of the area of the City of Phoenix). The State of Arizona uses over 61,000,000 MW-hrs. In addition the site should not be in the flight path of migratory birds.

Depending on what feed stock is being used, the availability of raw materials for a biomass plant could be a limitation. In Arizona it would probably be small or pest-infected trees, as well as brush. This would reduce the fire hazard in the forests and produce useful energy at the same time.

Despite the solicitude about the polluting properties of coal, this is now being seriously considered as the predominant source of future energy in the United States. Recently the Mohave Generating Station was shut down because of the pollutants it was spewing into the atmosphere, closing the Black Mesa Coal Mine. However, BHP is contemplating the El Segundo mine and a mine-mouth power plant in the Grants, New Mexico district across from the Arizona border. The Department of Energy is also considering a research project with Lawrence Livermore Laboratory involvement. Both these projects are expected to produce clean energy and not pollute the environment.

Many other organizations are planning similar projects in various parts of the country. A company in Pennsylvania is considering converting culm banks, produced from mining anthracite, into diesel fuel using the Fischer-Tropsch process. The synthetic gas produced may be burnt to produce power, the "integrated gasification combined-cycle" (IGCC). Peabody Energy is planning two plants, one in southern Illinois and another in

Arizona is again the # 1 mining state in the U.S. with \$4.7 billion in production!

Kentucky, which will not release any sulfur or nitrogen oxides. Several other projects are also on the drawing boards.

Nuclear power has a perception of being dangerous. However, such plants are being built and used extensively throughout the world. Currently 441 plants are in operation, producing 2.6 billion MW-hrs or 16 percent of the world's electric power, 24 are in construction, 40 are planned, and 73 have been proposed. The impetus is to reduce atmospheric pollution. In the past the properties of uranium were not well understood and people were needlessly exposed to it; this is no longer the case. Adequate systems for handling and disposal have now been developed. With the Energy Policy Act of 2005, new nuclear plants are now being aggressively studied in this country. Florida, Illinois, Mississippi, North and South Carolina, Pennsylvania, Tennessee, and Virginia, among other states, are now exploring the possibility of either erecting new facilities or adding units to existing plants.

This State is blessed with significant amounts of uranium, especially in the Arizona Strip. It occurs in the form of collapsed breccia pipes; vertical, pipelike structures, roughly 300 feet in diameter and about 3,000 feet deep. Often they occur in clusters. Although no mining is currently in progress, exploration companies are very active. The Palo Verde power plant west of Phoenix could accommodate two more units, although this is not being currently contemplated. The time may have come to consider new plants!

Copper News

Rosemont. Augusta Resource Corporation announced in May that it had positive results from test work at their Rosemont copper/molybdenum project near Tucson. The company is studying the feasibility of an open pit mine, concentrator and leaching facility with a concentrator production capacity of approximately 75,000 tons per day in order to produce 225 million pounds of recovered copper and over 5 million pounds of molybdenum over a 17-22-year period

Safford. Phelps Dodge Corp. announced that its board of directors has given conditional approval to develop its new copper mine near Safford. Final approval is contingent upon receiving certain state permits needed for the mine. The Safford mine will require a capital investment of approximately \$550 million. It will be the first major new copper mine to be opened in the United States in more than 30 years. Full production is expected in 2008 and is projected to be approximately 240 million pounds of copper a year. Life of the operation is expected to be at least 18 years.

Johnson Camp. Nord Resources Corp. obtained credit approval for a project debt facility of up to \$14 million for the reactivation of the Johnson Camp mine in Cochise County. Nord hopes to resume mining and leaching at Johnson Camp with a goal of producing 25 million pounds of cathode copper per year.

Source for Power	Benefits	Challenges
Coal	Abundant supply; readily obtained	Air emissions; possible global warming
Oil	Ease of use; source of many chemicals	Air emissions; limited resources; locations may not be desirable; spills cause serious damage
Gas	Relatively clean; burns efficiently	Could be put to better use; limited supplies
Nuclear	Non-polluting; sufficient supplies	Waste disposal; public perception of danger
Hydroelectric	Renewable resource; non-polluting	Few suitable sites; undesirable results from dams
Geothermal	Clean; available continuously	Limited locations; difficult to harness
Biomass	Eliminates waste; relatively inexpensive	Emissions; feed supplies could be limited
Solar	Inexhaustible; non-polluting	Requires long exposure to sunlight; high capital cost; storage is difficult
Wind	Renewable; non-polluting	Sporadic; requires large areas; hazardous to birds; unsightly; limited sites
Wave	Continuously available; renewable	Difficult to site; not in Arizona



Dr. Mary Poulton, at the PDAC Conference last year in Toronto, is flanked by two members of the Royal Canadian Mounted Police.

New Board Member Named

Governor Janet Napolitano appointed Mary M. Poulton to the Department's Board of Governors on December 20, 2005. Her 5-year term runs through January, 2012. Dr. Poulton is professor and Department Head for the University of Arizona's Department of Mining and Geological Engineering.

Dr. Poulton, a native of Illinois, moved to Tucson to attend the University of Arizona in 1982. She completed her B.S. degree in Geological Engineering, with emphasis on mining and exploration, in 1984. Upon completion of her Master of Science degree in 1987, and her Ph.D. in 1990, Dr. Poulton joined the faculty of the University of Arizona's Mining and Geological Engineering School. Her Ph.D. thesis was on, "Neural network pattern recognition of electromagnetic ellipticity images."

In 1999 Dr. Poulton was nominated for the National Carnegie Foundation Professor of the Year award and was also selected as a UA Wakonse Fellow. In previous years Dr. Poulton won the Excellence at the Student Interface Award in 1998, and in 1997 was selected for Marquis Who's Who in 1997 and Strathmore Who's Who.

Dr. Poulton has published numerous journal articles and conference papers on the application of computational neural networks to problems in the earth sciences, including geophysics, mining, mineral and petroleum exploration, hydrology, and atmospheric science. She is the author of a book on the use of neural networks for geophysical data analysis. Dr. Poulton has led or participated in research projects totaling over \$4 million in funding. Dr. Poulton's current research areas are geosensing in mine environments, reservoir characterization and water management. Dr. Poulton has taught a wide range of courses including geophysics field methods, mineral exploration, mineralogy and petrology for engineers, and neural network computing. She has directed numerous Masters and Ph.D. theses. She has

consulted for the US Bureau of Reclamation, the World Bank, and the American Geological Institute. She is co-founder and vice president of a water and energy management company, NOAH, LLC. She is currently the Chair of the Mining and Geothermal Committee of the Society of Exploration Geophysicists and is a past Vice President for the Engineering and Environmental Geophysics Society.

Dr. Poulton was appointed to serve on two National Research Council Committees for Geotechnical and Geological Engineering and to help develop a vision for research for the NSF for these areas. Dr. Poulton has testified before Congress on workforce issues in mining and petroleum engineering and helped develop the Energy and Mineral Schools Reinvestment Act. Dr. Poulton is the newly elected secretary of the American Geological Institute and has been appointed by the Secretary of Health and Human Services to chair the Mine Safety and Health Research Advisory Committee for NIOSH.



Do you need this information in an alternative format? Please call the Department at 602-255-3795.

From the Director's Desk

by Dr. Madan M. Singh

Governor Janet Napolitano signed the Department's Sunset Review legislation, House Bill 2508, into law on April 24, 2006. It became effective immediately, so the Department will now be able to continue operations through June 30, 2016. The DMMR staff and I would like to thank all our clients, stakeholders, and well-wishers for their support during the review and throughout the existence of the agency.

The Arizona Geological Survey (AGS) and DMMR have established a cooperative endeavor to sell each other's publications at our respective locations. Each agency has also made office space available for the other to use as necessary. We welcome Dr. M. Lee Allison to his new position as State Geologist and Director of AGS and expect that the two organizations will be cooperating on a number of other items in the future.

Mr. Doug Paterson, Consul & Senior Trade Commissioner for Canada in Phoenix, and DMMR staff have agreed to cooperate in matters of mutual interest. Since a number of companies operating in Arizona are registered on Canadian stock exchanges, this may be helpful.

For the first time since 1997 Arizona ranked No. 1 in the nation, producing \$4.7 billion worth of non-fuel minerals in 2005 according to preliminary data released by the US Geological Survey,

We hope to see many of you in the DMMR facilities in the near future, and I invite any of you that come by to stop in and say hello.

The Mining History Association will be holding their Annual Conference June 1 through June 4 in Globe at the Apache Gold Casino and Resort.

Field trips this year include a tour of the Phelps Dodge Rod Plant, the Morenci Open Pit, the Ray mine, and Roosevelt Dam.

The agenda for the two-day conference is varied and appealing.

For details visit the association's website at www.mininghistoryassociation.org/meeting.htm.

Museum News

by Susan Celestian

As it has been a while since I wrote about the goings-on at the Museum, let me catch everyone up.

In October, Friends of the Arizona Mining & Mineral Museum (FAMMM) and the Museum hosted a breakfast for the APS Hauling Group, as thanks for all their help. This is an amazing group of people, who have gone above and beyond the call of duty to help the Museum with many hauling projects. When we had to suddenly vacate the rock storage yard this past summer, they came to our rescue on very short notice! We are deeply indebted to them.

The Museum had two displays in the Arizona State Fair. In addition, the Museum sponsors two awards in the Minerals, Fossils, and Jewelry section of the State Fair. This year's awards went to: Erika Richardson, for Outstanding Junior exhibit; and to Shirley Cote, for Outstanding Adult Education exhibit. Shirley's exhibit on volcanoes is currently on display at the Museum, and Erika's collection will be on display very soon. I hope that they both will be an inspiration to our visitors – especially to the children who love rocks.

In December, I got to open up a very special package. J. David and Stephanie S. Walker donated fourteen spectacular faceted stones – including some very unusual species: kyanite, cerrusite, bi-colored topaz, apatite, and a big, raspberry-colored tourmaline! They will soon be on display in the "New Acquisitions" case. Our faceted gemstone collection has been greatly enhanced by their contributions the past three years. I think we are going to have to build a special case to show them off!

Finally, the exhibit season has been very busy – and we have had a national presence. In October, we exhibited at the Long Beach Show (California); in November we exhibited at the Carnegie Gem & Mineral Show (Pennsylvania) and Wickenburg Show; in January it was Rockfest in Phoenix; and in February, the Tucson Gem & Mineral Show. The Phoenix Gem & Mineral Show was last on our schedule this year. .



The Department welcomes Ed Bustya aboard.

On January 3 Ed Bustya joined the Department as Mining Engineer. Bustya received his geology degree from ASU in 1983. After graduation, he worked for DMMR before relocating to Portland. Bustya has also worked in the field of information technology and will be able to take over much of the Department's computer operations.

Bustya's skill at technical writing and programming led to many accomplishments and awards. He became one of the very first webmasters while doing work for Cray Research in the early 1990s and the failure analysis and tracking system that he developed for Sun Microsystems is still in use.

Bustya's other interests include photography, house building and remodeling, and alternative energy use. He has gained national recognition and awards for his bird photography.

Bustya's online documentation skills will serve the Department well. "I look forward to continuing the digitizing of the department's and museum's priceless body of information and making it more easily accessible to the public," Bustya said.

Tucson Gem and Mineral Show - 2006

From the parking-lot tents along the freeway to the Convention Center's high-end specimen dealers, the Tucson Gem Show that ended February 12 was a magnificent spectacle again this year. The show was blessed with gorgeous weather and a 'buying' crowd that seemed to appreciate the opportunity to browse the overwhelming concentration of rare and stunning specimens, fossils, jewels, beads, and trinkets.

The Tucson show is the largest in the world, with an estimated 50,000 people in attendance each year. The economic impact of the show is over \$76 million, according to the Metropolitan Tucson Convention and Visitors Bureau. The bureau estimates that travelers will spend 75,000 to 85,000 room-nights in Tucson during the show.

In addition to adding to the Museum collection and stocking up the Museum gift shop, staff from the Department were observed buying an unusual stibnite specimen from China, a tanzanite, a really spiny trilobite, some goblets and candle holders of Pakistan onyx, many strands of beads, some small antique bells from Tibet, numerous sets of 'rattlesnake eggs' (polished magnets that make a sound like a rattlesnake when thrown in the air), and many plates of Chinese food.

If you missed the fun this year, there is always next year. Check on show dates for the Tucson show as well as all Arizona gem shows on the Department's annual circular, available in hard copy and at the Department website.



Tempting offerings at the Tucson Gem Show



This was the view from the roof of our building on April 10 when over 100,000 marched in support of immigrant rights - the largest public demonstration in the history of Arizona.

BOARD OF GOVERNORS

Samuel O. Aubrey
Chairman - Sun Lakes

Dr. Raymond W. Grant - Vice Chairman
- Chandler

P.K. Rana Medhi
Member - Casa Grande

Dr. Patrick F. O'Hara
Member - Prescott

Dr. Mary M. Poulton
Member - Tucson

STAFF

Dr. Madan M. Singh -
Director

Nyal J. Niemuth -
Chief Engineer

Ed Bustya -
Mining Engineer

Diane Bain - Public
Information Officer

Jacqueline Hall -
Administrative Assistant

Tina Mendoza -
Clerk Typist

Susan Celestian -
Curator

Tour Guides

Liz Anderson

Ann Baker

Shirley Coté

Doug Duffy

Joanne Hesterman

Laurette Kennedy



Arizona Department of Mines & Mineral Resources
1502 West Washington
Phoenix, Arizona 85007

Address Correction Requested